

Received by Express Mail
Receipt No. HS223974045
on 12/14/00
pursuant to 37 C.F.R. 1.10.
by [Signature]

IP COMMUNICATION NETWORK SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates generally to a multi switched
5 network system (IP communication network system) capable of
reducing costs for equipment and operations by integrating a
switched circuit network such as a telephone network with an
IP (Internet Protocol) packet switched network such as the
Internet or the Intranet, and more particularly to an IP
10 communication interface device and a circuit switch for
facilitating a construction of this IP communication network
system.

With an advancement of a network technology as typified
by broadening the band of a local area network (LAN) and an
15 advancement of a PC technology as typified by attaining
multifunctions of a personal computer (PC) and a speed-up of
a CPU applied to the PC over the recent years, it is on the verge
of actualization in terms of utilization that voice data are
communicated at a high speed between the PCs on a plurality of
20 LANs.

Owing to the advancements of those technologies,
application software executed between the PCs on the Internet
(including the Intranet as far as it is not used in a particularly
limited terminology in this Specification) configured by the
25 LANs and wide area networks (WANs) and a hardware system
incorporating this package software, are rapidly put into the
market. This system is known as [Internet telephony].

09737192-121400

In the IP communication network system known as Internet telephony, an integration of the data communications with the voice communications involves the use of a VoIP (Voice over Internet Protocol) technology. This VoIP technology is that voices (audio data) are segmented into frames at an interval of a short time (on the order of, e.g., 20 sec), and transmitted and received in the form of packets by adding IP headers thereto on a network (IP network) based on a network layer protocol, i.e., Internet Protocol (IP) used on the Internet.

Further, there is promoted a development of an interface device, incorporating a gateway function for executing a communication protocol conversion between the telephone network and the Internet, for actualizing the communications between the telephone network and the Internet.

Generally, the Internet telephony can be operated at a lower cost than a speech (voice communication) on the phone through the conventional telephone network, and therefore a spread of the IP communication network system and services thereof is being accelerated.

A transmission (transfer) standard in this IP communication network system is not yet, however, established. What exists at the present is just ITU-T Recommendation H.450.2 (H.323) that defines the services within the Internet and the services in the conventional telephone network.

With diversification and a scale-up of the infrastructures for the communications, the users tend to separately use the communication infrastructure optimal to the purpose. Under

09737192-121400

such circumstances, it is necessary and indispensable to construct a more economical intra-office communication network system by taking the Internet into the intra-office communication network system and utilizing it for the data communications and
5 the voice communications as well.

SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the present invention to provide an IP communication network system, incorporating a gateway function for executing a communication
10 protocol conversion between a telephone network (switched circuit network) and the Internet (IP packet switched network), for actualizing a variety of communications such as voice communications and data communications between the telephone
15 network and the Internet.

It is another object of the present invention to provide an IP communication network system capable of its being easily introduced into an existing telephone network, especially an intra-office telephone network in order to actualize the variety
20 of communications between the telephone network and the Internet.

To accomplish the above objects, according to a first aspect of the present invention, an IP communication interface device comprises first and second connecting units for making it possible to dispose between a switched circuit network and
25 LAN connected to an IP packet switched network, a first processing unit for coding first media-corresponding data as B-channel data inputted to the first connecting unit from the switched circuit

09737192 121400

network, decoding packet-deassembled media-corresponding data into which a packet of second media-corresponding data inputted to the second connecting unit from the LAN is deassembled, and for transmitting the decoded media-corresponding data to the

5 first connecting unit for forwarding the same data as the first media-corresponding data to the switched circuit network, a second processing unit for assembling the coded media-corresponding data coded by the first processing unit into a packet, deassembling the packet of the second

10 media-corresponding data, and transmitting the same data as packet-deassembled media-corresponding data to the first processing unit, and a third processing unit for generating the second media-corresponding data by adding predetermined header data to the packet-assembled media-corresponding data assembled

15 into a packet by the second processing unit, forwarding the second media-corresponding data to the LAN via the second connecting unit, removing the header data added to the second media-corresponding data inputted to the second connecting unit, and transmitting the second media-corresponding data with the

20 header data removed to the second processing unit.

Based on this architecture, the first and second media-corresponding data may include voice data transmitted from a voice terminal having a voice communication function, facsimile data transmitted from a facsimile terminal having a facsimile

25 communication function and data transmitted from a data terminal having a data communication function.

Further, the first and second processing units may be

5 . selecting the first functionally divided processing unit in accordance with a command given from the third processing unit.

10 to which an RTP for enabling a real time transport to be done
is added.

15 from which the RTP for enabling the real time transport to be
done is removed.

20 and an IP header as the header data, and, when the packet-assembled
media-corresponding data are the essential data, may add a TCP
header and an IP header as the header data.

25 data, may remove the UDP header and the IP header added as the
header data, and, when the second media-corresponding data are
the essential data, may remove the TCP header and the IP header

added as the header data.

The third processing unit may identify a call control signal as D-channel data in accordance with a message based on a specified protocol, and may penetratingly transmit and receive
5 the call control signal simply by adding and removing the TCP header and the IP header.

The first and second connecting units and the first, second and third processing units may be mounted in a package card.

According to a second aspect of the present invention,
10 a circuit switch comprises a highway switch accommodating at least one of a voice terminal having a voice communication function, a facsimile terminal having a facsimile function and a data terminal having a data communication function, and including a time division multiplexing transmission path for
15 transmitting data corresponding to media, a first connecting unit connected directly to the highway switch, a second connecting unit for accommodating a LAN line connected to an IP packet switched network, a first processing unit for coding first media-corresponding data as B-channel data inputted to
20 the first connecting unit, decoding packet-deassembled media-corresponding data into which a packet of second media-corresponding data inputted to the second connecting unit is deassembled, and transmitting the decoded media-corresponding data to the first connecting unit in order
25 to forward the same decoded media-corresponding data as the first media-corresponding data to the highway switch, a second processing unit for assembling the coded media-corresponding

09737192-121400

data coded by the first processing unit, deassembling the packet of the second media-corresponding data, and transmitting the second media-corresponding data as the packet-deassembled media-corresponding data to the first processing unit, and a
5 third processing unit for generating the second media-corresponding data by adding predetermined header data to the packet-assembled media-corresponding data assembled into a packet by the second processing unit, forwarding the second media-corresponding data to the LAN via the second connecting
10 unit, removing the header data added to the second media-corresponding data inputted to the second connecting unit, and transmitting the second media-corresponding data with the header data removed to the second processing unit.

According to a third aspect of the present invention, an
15 IP communication network system includes a circuit switch comprising a highway switch accommodating at least one of a voice terminal having a voice communication function, a facsimile terminal having a facsimile function and a data terminal having a data communication function, and including a time division
20 multiplexing transmission path for transmitting data corresponding to media, a first connecting unit connected directly to the highway switch, a second connecting unit for accommodating a LAN line connected to an IP packet switched network, a first processing unit for coding first
25 media-corresponding data as B-channel data inputted to the first connecting unit, decoding packet-deassembled media-corresponding data into which a packet of second

00422 261260

media-corresponding data inputted to the second connecting unit is deassembled, and transmitting the decoded

media-corresponding data to the first connecting unit in order to forward the same decoded media-corresponding data as the first

5 media-corresponding data to the highway switch, a second processing unit for assembling the coded media-corresponding data coded by the first processing unit, deassembling the packet of the second media-corresponding data, and transmitting the second media-corresponding data as the packet-deassembled

10 media-corresponding data to the first processing unit, and a third processing unit for generating the second media-corresponding data by adding predetermined header data

to the packet-assembled media-corresponding data assembled into a packet by the second processing unit, forwarding the second

15 media-corresponding data to the LAN via the second connecting unit, removing the header data added to the second

media-corresponding data inputted to the second connecting unit, and transmitting the second media-corresponding data with the header data removed to the second processing unit.

20 According to a fourth aspect of the present invention, an IP communication network system includes an IP communication interface device comprising first and second connecting units for making it possible to dispose between a switched circuit network and LAN connected to an IP packet switched network, a

25 first processing unit for coding first media-corresponding data as B-channel data inputted to the first connecting unit from the switched circuit network, decoding packet-deassembled

004413400

media-corresponding data into which a packet of second media-corresponding data inputted to the second connecting unit from the LAN is deassembled, and for transmitting the decoded media-corresponding data to the first connecting unit for forwarding the same data as the first media-corresponding data to the switched circuit network, a second processing unit for assembling the coded media-corresponding data coded by the first processing unit into a packet, deassembling the packet of the second media-corresponding data, and transmitting the same data as packet-deassembled media-corresponding data to the first processing unit, and a third processing unit for generating the second media-corresponding data by adding predetermined header data to the packet-assembled media-corresponding data assembled into a packet by the second processing unit, forwarding the second media-corresponding data to the LAN via the second connecting unit, removing the header data added to the second media-corresponding data inputted to the second connecting unit, and transmitting the second media-corresponding data with the header data removed to the second processing unit.

According to the present invention, it is feasible to provide the IP communication network system, incorporating the gateway function for executing the communication protocol conversion between the telephone network (switched circuit network) and the Internet (IP packet switched network), for actualizing the variety of communications such as the voice communications and the data communications between the telephone network and the Internet.

09737192-121400

According to the present invention, it is also possible to provide the IP communication network system capable of its being easily introduced into the existing telephone network, especially the intra-office telephone network in order to
5 actualize the variety of communications between the telephone network and the Internet.

As a result, according to the present invention, it is easier to construct the economical circuit switch and IP communication network system.

BRIEF DESCRIPTION OF THE DRAWINGS

These objects and advantages of the present invention will become more apparent and more readily appreciated from the following detailed description of the presently preferred
15 exemplary embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a block diagram showing an architecture of an IP communication network system in one embodiment of the present invention;

20 FIG. 2 is an explanatory block diagram showing a first example of a private branch exchange (PBX) and an IP communication interface device and operations thereof;

FIG. 3 is a diagram showing a layout of a control unit and CODECs that are mounted as a package card in the IP
25 communication interface device;

FIG. 4 is an explanatory diagram showing a frame structure of a variety of packets transmitted and received between the

09737192-121400

IP communication interface device and a LAN line (Internet line);

FIG. 5 is an explanatory block diagram showing a second example of the PBX and the IP communication interface device and operations thereof;

5 FIG. 6 is an explanatory block diagram showing a third example of the PBX and the IP communication interface device and operations thereof; and

10 FIG. 7 is an explanatory block diagram showing a fourth example of the PBX and the IP communication interface device and operations thereof.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Next, embodiments of the present invention will hereinafter be discussed with reference to the accompanying drawings.

15 [Architecture of IP Communication Network System]

FIG. 1 shows an architecture of an IP communication network system in one embodiment of the present invention. Referring to FIG. 1, PBXs (private branch exchanges) 1, 2 configuring a telephone network as a switched circuit network respectively accommodate a plurality of terminal devices (which may be simply referred to as terminals in some cases) 3 and a plurality of terminals 4. These terminal 3, 4 are each classified as a telephone terminal incorporating a voice communication function, and a facsimile (FAX) terminal having a FAX communication function, or a data terminal such as a personal computer (PC) having a data communication function. Note that the PBXs 1, 2 may also be main devices corresponding to typical PBXs. Further,

20

25

004737 2612E60

the PBXs 1, 2 are connected to an ISDN relay line to a public switched network, however, their illustrations are herein omitted.

IP communication interface devices 5, 6 serve to connect the PBXs 1, 2 to local area networks (LANs) 7, 8, respectively. The IP communication interface devices 5, 6, which will hereinafter be described in depth, can be provided as package cards into the same boxes as those of the PBXs 1, 2. Unique IP addresses are allocated to the IP communication interface devices 5, 6.

In addition to the IP communication interface devices 5, 6, data terminals (not shown) such as PCs each having the data communication function and routers 9, 10 serving as relay (routing) devices, are connected to the LANs 7, 8. The LANs 7, 8 are configured based on a star network topology such as 10BASE-T (in which a trunk line transmission speed is 10 Mbps, a base band modulation method is adopted, and a transmission medium involves the use of a twisted pair cable) or 100BASE-TX, and may also be configured by using other network topologies such as a bus network.

An Internet 11 as an IP packet switched network (IP network) is connected to the routers 9, 10. This Internet 11 is strictly categorized as the Intranet when the IP packet switched network is an intra-office network, however, there is herein no particular distinction in terminology. Further, the Internet 11 is constructed of a leased line, ISDN LAN and WAN. The IP communication network system can be configured based on this

09737192-121400

architecture.

[First Example of Architectures and Operations of Private
Branch Exchange and IP communication Interface Device]
(Private Branch Exchange)

5 A first PBX 20 corresponding to the PBXs 1, 2 in IP
communication network system shown in FIG. 1, as illustrated
in FIG. 2, includes a voice terminal (subscriber) control unit
21, a highway switch 22, a trunk control unit 23 and a central
control unit 24.

10 The voice terminal control unit 21 accommodates a voice
terminal (telephone) 31 incorporating a voice communication
function through a subscriber line, and is connected to the
highway switch 22. The voice terminal control unit 21 controls
15 detection of calling, response and disconnection, controls a
receipt of dialing and controls a calling signal with respect
to the voice terminal 31. The voice terminal control unit 21
also controls receiving operations when the voice terminal 31
is set on a receiving side.

20 The highway switch 22 is constructed of a time division
multiplexing transmission path (Highway: HW) having $[nB + D]$
($n = 1 \sim 31$) channels, and has a capacity of, e.g., 2 Mbps (64
Kbps X 32 time slots TS). The trunk control unit 23 accommodates
an ISDN relay line of BRI (Basic Rate Interface, which is a basic
interface having a transmission speed of 192 Kbps) or PRI (Primary
25 Rate Interface, which is a primary group speed interface having
a transmission speed of 1.544/2.048 Mbps) that is connected to
the public switched network. The trunk control unit 23 serves

09737192-121400

to transmit and receive voice data (Bch data) of a B channel and control data (Dch data) of a D channel. Further, the trunk control unit 23 is connected directly to the highway switch 22.

The central control unit 24 switches the lines by controlling the voice terminal control unit 21, the highway switch 22 and the trunk control unit 23, respectively. Moreover, the central control unit 24 executes setting, canceling and outputting of station data via a maintenance/operation interface (unillustrated).

(IP Communication Interface Device)

Next, a first IP communication interface device 40 corresponding to the IP communication interface devices 5, 6 in the IP communication network system shown in FIG. 1, as illustrated in FIG. 2, includes a control unit 50 and a CODEC 60. The control unit 50 and the CODEC 60 are constructed of an individual or one piece of package card, and this package card is mounted as the IP interface device 40 into the same box as that of the PBX 20 described above. FIG. 3 is a diagram showing a layout of the control unit 50 and the CODECs 60, which are mounted in the single package card.

The control unit 50 comprises a highway switch interface (that will hereinafter be abbreviated to HW-IF in some cases) 51, a LAN interface (that will hereinafter be abbreviated to LAN-IF as the case may be) 52, a signal processing unit 53 provided in a CPU (Central Processing Unit), and an internal bus 54. The control unit 50 transmits and receives packets corresponding to media with an Internet line via a LAN line, which are voice

09737192 121400

packets in this example. Further, the control unit 50 is connected to the highway switch 22 of the PBX 20 and to the LANs 7, 8, and controls the CODECs 60 to assemble and deassemble the packets of data corresponding to the media, i.e., the voice data
5 in this example.

The HW-IF 51 connected directly to the highway of the highway switch 22 takes line data of 64 Kbps out of this highway (a transmission speed thereof is, e.g., 2 Mbps) and inserts the line data of 64 Kbps into the highway of the highway switch 22.
10 The LAN-IF 52 is connected to the LANs 7, 8 and controls electric/physical interfaces of the LAN lines in the LAN topology, i.e., 10BASE-T or 100BASE-TX in this example. The signal processing unit 53 establishes calls between connection type communications on the side of the switched circuit network of
15 the PBX 20 and connectionless type communications on the side of the Internet, and processes an end call control signal.

Further, the CODEC 60 connected to the control unit 50 is constructed of a dropper/inserter (which hereinafter might be referred to as TS-CNTL) 61, a dual port memory (which
20 hereinafter might be termed DPRAM) 62, a first processing unit 62 composed of a digital signal processor (DSP) and having a coding/decoding function, a second processing unit 64 provided in the CPU and having a packet assembling/deassembling function, and an internal bus 65. The CODEC 60 assembles and deassembles
25 the packet of the data corresponding to the media, i.e., the voice data in this example.

The TS-CNTL 61 takes the data out of a 64 Kbps time slot

09737192.121400

of an internal transmission path between the control unit 50 and the CODEC 60, and inserts the data into the same time slot. The DPRAM 62 enables the signal processing unit 53 of the control unit 50 and the second processing unit 64 of the CODEC 60 to
5 perform the internal communications therebetween.

The first processing unit 63 executes a process of coding continuous signals of the voice data taken out of the time slot in the TS-CNTL 61 into discrete signals of the voice packet to the Internet line. Further, the first processing unit 63
10 executes a process of decoding the voice packet forwarded from the Internet line into the continuous signals of the voice data, whereby the decoded signals can be inserted into the predetermined time slot in the TS-CNTL 61.

The second processing unit 64 controls the first processing unit 63, and executes the packet assembly including an addition of RTP (Real Time Transport Protocol) for enabling a real time transport to be carried out and a packet deassembly including an elimination of RTP. Note that the CODECs 60 are extensible corresponding to an increase in the number of output channels
15 to the LANs 7, 8 from the IP communication interface device 40.
20

The IP communication interface device 40 is connected directly to the highway of the highway switch 22 via the HW-IF 51, and may therefore be treated as a [trunk device] embraced by the ISDN relay line as viewed from the PBX 20.

25 (Operation)

In the first IP communication interface device 40 taking the architecture described above, the voice data (Bch data) are

00737192.121400

inputted via the HW-IF 51 of the control unit 50 to the TS-CNTL 61 of the CODEC 60 from the highway switch 22 of the PBX 20.

The voice data inputted to the TS-CNTL 61 are coded in the first processing unit 63 and subjected to a voice compression and a silence compression according to ITU-T G.729 Annex A/B. The coded voice data, which have been thus compressed, are transmitted to the second processing unit 64 via the internal bus 65 from the first processing unit 63. The second processing unit 64 adds RTP to the coded voice data, thereby assembling a voice packet. This voice packet is transferred to the signal processing unit 53 of the control unit 50 via the DPRAM 62 and the internal bus 54 as well.

The signal processing unit 53 assembles a voice packet by adding a UDP (User Datagram Protocol) header and an IP (Internet Protocol) header to the former voice packet received from the CODEC 60, and forwards this assembled voice packet to the LAN lines connected to the LANs 7, 8 via the LAN-IF 52. FIG. 4(A) shows a frame structure of the voice packet on the LAN line and the Internet line.

Further, the control data (Dch data) of the call control signal etc corresponding to a TTC Standard JT-Q.931 message, are inputted to the signal processing unit 53 via the HW-IF 51 of the control unit 50 and the internal bus from the highway switch 22 of the PBX 20.

The signal processing unit 53 assembles a control data packet based on a frame structure shown in FIG. 4(D) by adding a TCP (Transmission Control Protocol) header and an IP header

004422 267260

to the received control data. This control data packet is forwarded to the LAN lines connected to the LANs 7, 8 via the LAN-IF 52.

On the other hand, when the voice packet is inputted to the IP communication interface device 40 from the LAN line, the voice packet is deassembled and decoded into Bch voice data through processing steps opposite to those described above. The Bch voice data are then transmitted to the highway switch 22 of the PBX 20.

Further, when the control data packet is inputted to the IP communication interface device 40 from the LAN line, the packet is deassembled through processing steps opposite to those explained above into Dch control data, and the Dch control data are transmitted to the highway switch 22 of the PBX 20. Namely, the IP communication interface device 40 transparently transmits and receives the control data between the PBX 20 and the LANs 7, 8.

[Second Example of Architectures and Operations of Private Branch Exchange and IP communication Interface Device]

(Private Branch Exchange)

A second PBX 20 corresponding to the PBXs 1, 2 in IP communication network system shown in FIG. 1, as illustrated in FIG. 5, includes a facsimile (FAX) terminal control unit 25, the highway switch 22, the trunk control unit 23 and the central control unit 24.

The FAX terminal control unit 25 accommodates a facsimile (FAX) terminal (telephone) 32 incorporating a FAX

004737192 121400

communication function through a FAX line, and is connected to the highway switch 22. The FAX terminal control unit 25 controls a transmission, a receipt and a disconnection with respect to the FAX terminal 32.

5 The highway switch 22 is constructed of a time division multiplexing transmission path (Highway: HW) having $[nB + D]$ ($n = 1 \sim 31$) channels, and has a capacity of, e.g., 2 Mbps (64 Kbps X 32 time slots TS). The trunk control unit 23 accommodates the ISDN relay line of BRI or PRI that is connected to the public
10 switched network. The trunk control unit 23 serves to transmit and receive FAX data (Bch data) of the B channel and control data (Dch data) of the D channel. Further, the trunk control unit 23 is connected directly to the highway switch 22.

 The central control unit 24 switches the lines by
15 controlling the FAX terminal control unit 25, the highway switch 22 and the trunk control unit 23, respectively. Moreover, the central control unit 24 executes setting, canceling and outputting of station data via the maintenance/operation interface (unillustrated).

20 (IP Communication Interface Device)

 Next, a second IP communication interface device 40 corresponding to the IP communication interface devices 5, 6 in the IP communication network system shown in FIG. 1, as illustrated in FIG. 5, includes the control unit 50 and a CODEC
25 70. The control unit 50 and the CODEC 70 are constructed of an individual or one piece of package card, and this package card is mounted as the IP interface device 40 into the same box

00737192-121400

The control unit 50 comprises the highway switch interface (HW-IF) 51, the LAN interface (LAN-IF) 52, the signal processing unit 53 provided in the CPU, and the internal bus 54. The control unit 50 transmits and receives packets corresponding to media with the Internet line via the LAN line, which are FAX packets in this example. Further, the control unit 50 is connected to the highway switch 22 of the PBX 20 and to the LANs 7, 8, and controls the CODECs 70 to assemble and deassemble the packets of data corresponding to the media, i.e., the FAX data in this example.

Further, the CODEC 70 connected to the control unit 50 is constructed of a dropper/insertor (TS-CNTL) 71, a dual port

memory (DPRAM) 72, a first processing unit 73 composed of a digital signal processor (DSP) and having a coding/decoding function, a second processing unit 74 provided in the CPU and having a packet assembling/deassembling function, and an internal bus 75. The CODEC 70 assembles and deassembles the packet of the data corresponding to the media, i.e., the FAX data in this example.

The TS-CONTL 71 takes the data out of a 64 Kbps time slot of an internal transmission path between the control unit 50 and the CODEC 70, and inserts the data into the same time slot. The DPRAM 72 enables the signal processing unit 53 of the control unit 50 and the second processing unit 74 of the CODEC 70 to perform the internal communications therebetween.

The first processing unit 73 executes a process of coding continuous signals of the FAX data taken out of the time slot in the TS-CNTL 71 into discrete signals of the FAX packet to the Internet line. Further, the first processing unit 73 executes a process of decoding the FAX packet forwarded from the Internet line into the continuous signals of the FAX data, whereby the decoded signals can be inserted into the predetermined time slot in the TS-CNTL 71.

The second processing unit 74 controls the first processing unit 73, and executes the packet assembly including the addition of RTP for enabling the real time transport to be carried out and a packet deassembly including the elimination of RTP. Note that the CODECs 70 are extensible corresponding to an increase in the number of output channels to the LANs 7, 8 from the IP

00449.12400
00449.12400

communication interface device 40.

The second IP communication interface device 40 is connected directly to the highway of the highway switch 22 via the HW-IF 51, and may therefore be treated as the [trunk device] embraced by the ISDN relay line as viewed from the PBX 20.

(Operation)

In the second IP communication interface device 40 taking the architecture described above, the FAX data (Bch data) having a transmission speed of G3 are inputted via the HW-IF 51 of the control unit 50 to the TS-CNTL 71 of the CODEC 70 from the highway switch 22 of the PBX 20.

The FAX data inputted to the TS-CNTL 71 are coded based on a FAX relay method of FRP.11 in the first processing unit 73 having automatically detected inter-FAX-terminal signals. The coded FAX data are transmitted to the second processing unit 74 via the internal bus 75 from the first processing unit 73. The second processing unit 74 adds RTP to the coded FAX data, thereby assembling a FAX packet. This FAX packet is transferred to the signal processing unit 53 of the control unit 50 via the DPRAM 72 and the internal bus 54 as well.

The signal processing unit 53 assembles a FAX packet by adding a UDP header and an IP header to the former FAX packet received from the CODEC 70, and forwards this assembled FAX packet to the LAN lines connected to the LANs 7, 8 via the LAN-IF 52. FIG. 4(B) shows a frame structure of the FAX packet on the LAN line and the Internet line.

On the other hand, when the FAX packet is inputted to the

5 PBX 20.

10 first IP communication interface device 40 described above.

(Private Branch Exchange)

15 communication network system shown in FIG. 1, as illustrated in FIG. 6, includes a data terminal control unit 26, the highway switch 22, the trunk control unit 23 and the central control unit 24.

terminal 33 incorporating a data communication function through a data line, and is connected to the highway switch 22. The data terminal control unit 26 controls a transmission and a receipt with respect to the data terminal 33.

25 multiplexing transmission path (Highway: HW) having $[nB + D]$
($n = 1 \sim 31$) channels, and has a capacity of, e.g., 2 Mbps (64
Kbps X 32 time slots TS). The trunk control unit 23 accommodates

the ISDN relay line of BRI or PRI that is connected to the public switched network. The trunk control unit 23 serves to transmit and receive 64 Kbps non-limited digital data (Bch data) of the B channel and control data (Dch data) of the D channel. Further, the trunk control unit 23 is connected directly to the highway switch 22.

The central control unit 24 switches the lines by controlling the data terminal control unit 26, the highway switch 22 and the trunk control unit 23, respectively. Moreover, the central control unit 24 executes setting, canceling and outputting of station data via the maintenance/operation interface (unillustrated).

(IP Communication Interface Device)

Next, a third IP communication interface device 40 corresponding to the IP communication interface devices 5, 6 in the IP communication network system shown in FIG. 1, as illustrated in FIG. 6, includes the control unit 50 and a CODEC 80. The control unit 50 and the CODEC 80 are constructed of an individual or one piece of package card, and this package card is mounted as the IP interface device 40 into the same box as that of the PBX 20 described above. A layout of the control unit 50 and the CODECs 80, which are mounted in the single package card, is the same as that shown in FIG. 3.

The control unit 50 comprises a highway switch interface (HW-IF) 51, a LAN interface (LAN-IF) 52, a signal processing unit 53 provided in the CPU, and an internal bus 54. The control unit 50 transmits and receives packets corresponding to media

with the Internet line via the LAN line, which are data packets in this example. Further, the control unit 50 is connected to the highway switch 22 of the PBX 20 and to the LANs 7, 8, and controls the CODECs 80 to assemble and deassemble the packets of data corresponding to the media in this example.

The HW-IF 51 connected directly to the highway of the highway switch 22 takes line data of 64 Kbps out of this highway (a transmission speed thereof is, e.g., 2 Mbps) and inserts the line data of 64 Kbps into the highway of the highway switch 22.

10 The LAN-IF 52 is connected to the LANs 7, 8 and controls the electric/physical interfaces of the LAN lines in the LAN topology, i.e., 10BASE-T or 100BASE-TX in this example. The signal processing unit 53 establishes calls between the connection type communications on the side of the switched circuit network of the PBX 20 and the connectionless type communications on the side of the Internet, and processes the end call control signal.

Further, the CODEC 80 connected to the control unit 50 is constructed of a dropper/inserter (TS-CNTL) 81, a dual port memory (DPRAM) 82, a first processing unit 83 composed of a digital signal processor (DSP) and having a coding/decoding function, a second processing unit 84 provided in the CPU and having a packet assembling/deassembling function, and an internal bus 85. The CODEC 80 assembles and deassembles the packet of the data corresponding to the media in this example.

25 The TS-CNTL 81 takes the data out of a 64 Kbps time slot of an internal transmission path between the control unit 50 and the CODEC 80, and inserts the data into the same time slot.

004T21"267E260

The DPRAM 82 enables the signal processing unit 53 of the control unit 50 and the second processing unit 84, which will be explained later on, of the CODEC 80 to perform the internal communications therebetween.

5 The first processing unit 83 executes a process of coding continuous signals of the data taken out of the time slot in the TS-CNTL 81 into discrete signals of the data packet to the Internet line. Further, the first processing unit 83 executes a process of decoding the data packet forwarded from the Internet
10 line into the continuous signals of the data, whereby the decoded signals can be inserted into the predetermined time slot in the TS-CNTL 81. Note that the first processing unit 83 neither compresses nor extends the data, and, instead, there may be taken a process of merely letting the data through.

15 The second processing unit 84 controls the first processing unit 83, and assembles and deassembles the packets. Note that the CODECs 80 are extensible corresponding to an increase in the number of output channels to the LANs 7, 8 from the IP communication interface device 40.

20 The third IP communication interface device 40 described above is connected directly to the highway of the highway switch 22 via the HW-IF 51, and may therefore be treated as a [trunk device] embraced by the ISDN relay line as viewed from the PBX 20.

25 (Operation)

In the third IP communication interface device 40 taking the architecture described above, the 64 Kbps non-limited digital

00737193-121400

data (Bch data) excluding the FAX data having the transmission speed of G3 are inputted via the HW-IF 51 of the control unit 50 to the TS-CNTL 81 of the CODEC 80 from the highway switch 22 of the PBX 20.

5 The data inputted to the TS-CNTL 81 are coded in the first processing unit 83. The coded data are transmitted to the second processing unit 84 via the internal bus 85 from the first processing unit 83. The second processing unit 84, based on the coded data, assembles a data packet. This data packet is
10 transferred to the signal processing unit 53 of the control unit 50 via the DPRAM 82 and the internal bus 54 as well.

 The signal processing unit 53 assembles a data packet by adding a TCP header and an IP header to the former data packet received from the CODEC 80, and forwards this assembled data
15 packet to the LAN lines connected to the LANs 7, 8 via the LAN-IF 52. FIG. 4(C) shows a frame structure of the data packet on the LAN line and the Internet line.

 On the other hand, when the data packet is inputted to the IP communication interface device 40 from the LAN line, the
20 data packet is deassembled and decoded into Bch data through processing steps opposite to those described above. The Bch data are then transmitted to the highway switch 22 of the PBX 20.

 Note that the processes of transmitting and receiving the
25 control data (Dch data) of the call control signal etc corresponding to the TTC Standard JT-Q.931 message in this IP communication interface device 40, are the same as those in the

00422192 121400

first IP communication interface device 40 described above.

[Fourth Example of Architectures and Operations of Private
Branch Exchange and IP communication Interface Device]
(Private Branch Exchange)

5 A fourth PBX 20 corresponding to the PBXs 1, 2 in IP
communication network system shown in FIG. 1, as illustrated
in FIG. 7, includes the voice terminal (subscriber) control unit
21, the facsimile (FAX) terminal control unit 25, the highway
switch 22, the trunk control unit 23 and the central control
10 unit 24.

The voice terminal control unit 21 accommodates a voice
terminal (telephone) 31 corresponding to the communication
terminal devices 3, 4 and incorporating a voice communication
function through a subscriber line, and is connected to the
15 highway switch 22. The voice terminal control unit 21 controls
detection of calling, response and disconnection, controls a
receipt of dialing and controls a calling signal with respect
to the voice terminal 31. The voice terminal control unit 21
also controls receiving operations when the voice terminal 31
20 is set on a receiving side.

The FAX terminal control unit 25 accommodates a facsimile
(FAX) terminal 32 corresponding to the communication terminal
devices 3, 4 and incorporating a FAX communication function
through a FAX line, and is connected to the highway switch 22.
25 The FAX terminal control unit 25 controls a transmission, a
receipt and a disconnection with respect to the FAX terminal
32.

00737192-124400

The data terminal control unit 26 accommodates a data terminal 33 such as a PC corresponding to the communication terminal devices 3, 4 and incorporating a data communication function through a data line, and is connected to the highway switch 22. The data terminal control unit 26 controls a transmission and a receipt with respect to the data terminal 33.

The highway switch 22 is constructed of a time division multiplexing transmission path (Highway: HW) having $[nB + D]$ ($n = 1 \sim 31$) channels, and has a capacity of, e.g., 2 Mbps (64 Kbps X 32 time slots TS). The trunk control unit 23 accommodates the ISDN relay line of BRI or PRI that is connected to the public switched network. The trunk control unit 23 serves to transmit and receive the voice data, the FAX data or the data (Bch data) of the B channel and control data (Dch data) of the D channel. Further, the trunk control unit 23 is connected directly to the highway switch 22.

The central control unit 24 switches the lines by controlling the voice terminal control unit 21, the FAX terminal control unit 25, the data terminal control unit 26, the highway switch 22 and the trunk control unit 23, respectively. Moreover, the central control unit 24 executes setting, canceling and outputting of station data via the maintenance/operation interface (unillustrated).

(IP Communication Interface Device)

Next, a fourth IP communication interface device 40 corresponding to the IP communication interface devices 5, 6

00422-267260

in the IP communication network system shown in FIG. 1, as illustrated in FIG. 7, includes the control unit 50 and a CODEC 90. The control unit 50 and the CODEC 90 are constructed of an individual or one piece of package card, and this package card is mounted as the IP interface device 40 into the same box as that of the PBX 20 described above. A layout of the control unit 50 and the CODECs 90, which are mounted in the single package card, is the same as that shown in FIG. 3.

The control unit 50 comprises the highway switch interface (HW-IF) 51, the LAN interface (LAN-IF) 52, the signal processing unit 53 provided in the CPU, and the internal bus 54. The control unit 50 transmits and receives packets corresponding to media with the Internet line via the LAN line, which are the voice packets, the FAX packets or the data packets. Further, the control unit 50 is connected to the highway switch 22 of the PBX 20 and to the LANs 7, 8, and controls the CODECs 90 to assemble and deassemble the packets of data corresponding to the media.

The HW-IF 51 connected directly to the highway of the highway switch 22 takes line data of 64 Kbps out of this highway (the transmission speed thereof is, e.g., 2 Mbps) and inserts the line data of 64 Kbps into the highway of the highway switch 22. The LAN-IF 52 is connected to the LANs 7, 8 and controls the electric/physical interfaces of the LAN lines in the LAN topology, i.e., 10BASE-T or 100BASE-TX in this example. The signal processing unit 53 establishes calls between the connection type communications on the side of the switched circuit network of the PBX 20 and the connectionless type

communications on the side of the Internet, and processes the end call control signal.

Further, the CODEC 90 connected to the control unit 50 is constructed of a dropper/insertter (TS-CNTL) 91, a dual port
5 memory (DPRAM) 92, a first voice processing unit 931, a first FAX processing unit 932 and a first data processing unit 933 each composed of a digital signal processor (DSP) and having a coding/decoding function, a second voice processing unit 941, a second FAX processing unit 942 and a second data processing
10 unit 943 each provided in the CPU and having a packet assembling/deassembling function, an internal bus 95 and a selector 96. The CODEC 90 assembles and deassembles the packet of the data corresponding to the media.

The TS-CNTL 91 takes the data out of a 64 Kbps time slot
15 of an internal transmission path between the control unit 50 and the CODEC 90, and inserts the data into the same time slot. The DPRAM 92 enables the signal processing unit 53 of the control unit 50 and the second processing units 941, 942, 943 of the CODEC 90 to perform the internal communications therebetween.

20 The first voice processing unit 931 executes a process of coding continuous signals of the voice data taken out of the time slot in the TS-CNTL 91 into discrete signals of the voice packet to the Internet line. Further, the first voice processing unit 931 executes a process of decoding the voice
25 packet forwarded from the Internet line into the continuous signals of the voice data, whereby the decoded signals can be inserted into the predetermined time slot in the TS-CNTL 91.

09737196.121400

The first FAX processing unit 932 executes a process of coding continuous signals of the FAX data taken out of the time slot in the TS-CNTL 91 into discrete signals of the FAX packet to the Internet line. Further, the first FAX processing unit 5 932 executes a process of decoding the FAX packet forwarded from the Internet line into the continuous signals of the FAX data, whereby the decoded signals can be inserted into the predetermined time slot in the TS-CNTL 91.

004T2T"26TZEZ60
10 The first data processing unit 933 executes a process of coding continuous signals of the data taken out of the time slot in the TS-CNTL 91 into discrete signals of the data packet to the Internet line. Further, the first data processing unit 933 executes a process of decoding the data packet forwarded from the Internet line into the continuous signals of the data, whereby 15 the decoded signals can be inserted into the predetermined time slot in the TS-CNTL 91. Note that the first data processing unit 933 neither encodes nor decodes the data, and, instead, there may be taken a process of merely letting the data through.

20 The second voice processing unit 941 and the second FAX processing unit 942 control the first voice processing unit 93a and the first FAX processing unit 932 corresponding thereto, and executes the packet assembly including the addition of RTP for enabling the real time transport to be carried out and a packet deassembly including the elimination of RTP.

25 The second data processing unit 943 controls the first data processing unit 933, and executes the packet assembly and the packet deassembly.

The selector 96 receives a switching signal from the signal processing unit 53, and selects the first voice processing unit 931 or the first FAX processing unit 932 or the first data processing unit 933 in accordance with a content of this switching
5 signal, i.e., the media specified. Note that the CODECs 90 are extensible corresponding to an increase in the number of output channels to the LANs 7, 8 from the IP communication interface device 40.

The fourth IP communication interface device 40 is
10 connected directly to the highway of the highway switch 22 via the HW-IF 51, and may therefore be treated as the [trunk device] embraced by the ISDN relay line as viewed from the PBX 20.

(Operation)

In the fourth IP communication interface device 40 taking
15 the architecture described above, the voice data, the FAX data having the transmission speed of G3, or the 64 Kbps non-limited digital data are inputted as the Bch data via the HW-IF 51 of the control unit 50 to the TS-CNTL 91 of the CODEC 90 from the highway switch 22 of the PBX 20.

20 The signal processing unit 53 of the control unit 50 distinguishes between items of media data corresponding to the voice data, the FAX data and the data inputted from the highway switch 22 of the PBX 20 via the HW-IF 51, and transmits a switching signal to the selector 96.

25 The selector 96 receives the switching signal from the signal processing unit 53, and selects the first voice processing unit 931, or the first FAX processing unit 932 or the first data

004421"2677560

processing unit 933 in accordance with a content of this switching signal, i.e., the media specified.

004T2T" 26T2E260
10 To describe it in greater details, the signal processing unit 53 of the control unit 50, when detecting a Dch signal in which a transmission capability data element as the media data is non-limited digital, transmits the switching signal to the selector 96 via the HW-IF 51 and TS-CNTL 91. The selector 96 receiving the switching signal from the signal processing unit 53, selects the first data processing unit 933 in accordance with the media specified. Further, the signal processing unit 53 of the control unit 50, when detecting a Dch signal in which the transmission capability data element as the media data is not non-limited digital, transmits the switching signal to the selector 96 on the same route. Then, the selector 96 selects 15 the first voice processing unit 931. This process is the same irrespective of whether the IP communication interface device 40 is set on the transmitting side or on the receiving side.

20 The signal processing unit 53, when detecting a NSF (Non Standard Facilities) or DIS (Digital Identification Signal) given from the FAX terminal 32 accommodated in the PBX 20, identifies that the terminal is the FAX terminal 32 on the receiving side, and transmits the switching signal to the selector 96 on the same route as the above. Then, the selector 96 selects the first FAX processing unit 932. At this time, 25 the signal processing unit 53 transmits a [switching] Dch signal to the transmission-sided IP communication interface device 40 on the opposite side via the LAN line.

5

10

15

25

received from the CODEC 90, and forwards this assembled voice packet to the LAN lines connected to the LANs 7, 8 via the LAN-IF 52. The frame structure of the voice packet on the LAN line and the Internet line is as shown in FIG. 4(A).

5 On the other hand, when the voice packet is inputted to the IP communication interface device 40 from the LAN line, the voice packet is deassembled and decoded into Bch voice data through processing steps opposite to those described above. The Bch voice data are then transmitted to the highway switch 22
10 of the PBX 20.

 The FAX data inputted to the TS-CNTL 91 are coded based on the FAX relay method of FRP.11 in the first FAX processing unit 932 having automatically detected inter-FAX-terminal signals through the selector 96. The coded FAX data are
15 transmitted to the second FAX processing unit 942 via the internal bus 95 from the first FAX processing unit 932. The second FAX processing unit 942 adds RTP to the coded FAX data, thereby assembling a FAX packet. This FAX packet is transferred to the signal processing unit 53 of the control unit 50 via the DPRAM
20 92 and the internal bus 54 as well.

 The signal processing unit 53 assembles a FAX packet by adding a UDP header and an IP header to the former FAX packet received from the CODEC 90, and forwards this assembled FAX packet to the LAN lines connected to the LANs 7, 8 via the LAN-IF
25 52. The frame structure of the FAX packet on the LAN line and the Internet line is as shown in FIG. 4(B).

 On the other hand, when the FAX packet is inputted to the

004721"2672E260

control data (Dch data) of the call control signals which correspond to the TTC Standard JT-Q.931 message in this IP communication interface device 40, is the same as that in the first IP communication interface device 40 described above.

5 The function of the fourth IP communication interface device 40 explained above will be described more specifically. The function that will hereinafter be explained is the same as that of each of the first, second and third IP communication interface devices 40.

10 The signal processing unit 53 of the control unit 50 extracts a forwarding target number, i.e., an office number and an extension number out of received number data elements of the call control signals (Q.931 message) serving as the Dch control data from the PBX 20, then determines an IP address of a destination
15 (addressee) of the connection on the basis of the office number, and executes address mapping. Subsequently, the signal processing unit 53 sets the determined IP address in the IP header, and transmits the voice packet or the FAX packet or the data packet to the LAN line via the LAN-IF 52. On the other hand,
20 the signal processing unit 53 of the control unit 50, when receiving the voice packet or the FAX packet or the data packet from the LAN line via the LAN-IF 5, extracts only the received number data elements of the call control signal, viz., executes a receiving process without performing the address mapping unlike
25 the transmitting process.

Further, with respect to the Internet 11 in which the routers 9, 10 capable of controlling the priority of the voice

09737192.121400

packets are disposed, the signal processing unit 53 of the control unit 50, indicates the routers 9, 10 to set the priority by use of TOS (Type of Service) fields of the IP headers, and restrains a delay of forwarding the voice packets.

5 The second voice processing unit 943 of the CODEC 90 rearranges a sequence of regeneration within a range of the accumulated voice packet data. Namely, the second voice processing unit 943, if a transmission sequence of the voice data arrived is smaller than a transmission sequence of the
10 accumulated voice packet data, regenerates the voice data by decoding in the smaller transmission sequence.

 A PB (Push Button) signal received in in-channel band from the PBX 20 is temporarily received and encoded in the CODEC 90, and the signal processing unit 53 of the control unit 50 converts
15 it into a call control signal (Q.931 message) and transmits the call control signal to the LAN line. When the PB signals are inputted in the form of control data from the LAN line via the Internet line, the control unit 50 indicates the first voice processing unit 931 of the CODEC 90 to convert these signals
20 into analog PB signals. The decoded PB signals are transmitted to the PBX 20 via the TS-CNTL 91 and the HW-IF 51 from the first voice processing unit 931.

 Software of the CPU of the control unit 50 provided with the signal processing unit 53 and software of the CPU of the
25 CODEC 90 provided with the second processing units 941, 942, 943, can be downloaded from outside via LAN ports based on TCP/IP (10BASE-T or 100BASE-TX).

09319-1400

Further, it is feasible to obtain statistic data, fault data and trace data from outside via the LAN ports based on TCP/IP (10BASE-T or 100BASE-TX). Namely, in the IP communication interface device 40, various items of statistic data such as
5 the number of transmitted/received packets and a line activity ratio are collected and accumulated in order to grasp an operation state and actualize an effective utilization of the line. Further, the data about faults occurred during the operation are collected and accumulated as a log. The Dch data of the
10 call control signals are collected and accumulated as the trace data for monitoring the transmitted/received data.

Although only a few embodiments of the present invention have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible
15 in the preferred embodiments without departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of the present invention as defined by the following claims.

004221 267260

WHAT IS CLAIMED IS:

1. An IP communication interface device comprising:

first and second connecting units for making it possible
to dispose between a switched circuit network and LAN connected
5 to an IP packet switched network;

a first processing unit for coding first
media-corresponding data as B-channel data inputted to said first
connecting unit from said switched circuit network, decoding
packet-deassembled media-corresponding data into which a packet
10 of second media-corresponding data inputted to said second
connecting unit from said LAN is deassembled, and for
transmitting the decoded media-corresponding data to said first
connecting unit for forwarding the same data as the first
media-corresponding data to said switched circuit network;

15 a second processing unit for assembling the coded
media-corresponding data coded by said first processing unit
into a packet, deassembling the packet of the second
media-corresponding data, and transmitting the same data as
packet-deassembled media-corresponding data to said first
20 processing unit; and

a third processing unit for generating the second
media-corresponding data by adding predetermined header data
to the packet-assembled media-corresponding data assembled into
a packet by said second processing unit, forwarding the second
25 media-corresponding data to said LAN via said second connecting
unit, removing the header data added to the second
media-corresponding data inputted to said second connecting unit,

004737192-121400